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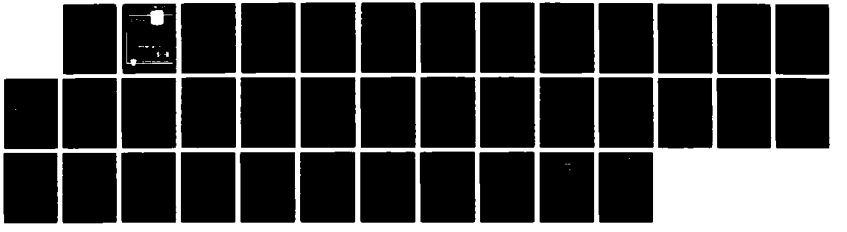

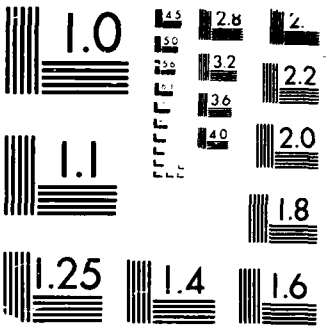

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STUDY PROJECT

EVALUATION OF SINCGARS CAPABILITY AND INTEROPERABILITY WITH RESPECT TO THE NAVY AND MARINE CORPS

BY

COMMANDER KENNETH G. APP, USN

28 MARCH 1988

U.S. ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013-5050

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To win a war global in nature, we will have to fight together. One service alone never could, nor will, win by itself. Effective command, control and communications are essential on yesterday's and today's battlefield. However, history has shown us that we have failed to master this element from the Korean Conflict to the invasion of Greneda. Electronic warfare may hinder or even deny the use of tactical communications. We therefore must have communication systems that are capable against the threat and are interoperable

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USAWC MILITARY STUDIES PROGRAM PAPER

EVALUATION OF SINCGARS CAPABILITY AND INTEROPERABILITY WITH RESPECT TO THE NAVY AND MARINE CORPS

AN INDIVIDUAL STUDY PROJECT

by

Commander Kenneth G. App, USN

Colonel Charles S. Palmer
Project Advisor

U.S. Army War College
Carlisle Barracks, Pennsylvania 17013
28 March 1988

ABSTRACT

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EVALUATION OF SINCGARS CAPABILITY AND INTEROPERABILITY WITH RESPECT TO THE NAVY AND MARINE CORPS

CHAPTER I

INTRODUCTION

We now live in a Military where jointness is the new watchword. Is this just lip service to a congressional desire, or is it a realization that to win a war global in nature, we will have to fight together and do it well? I believe it is the latter. To do this we must have systems that are capable and interoperable or even common. In addition, we must reduce procurement costs and development time for today's expensive and sophisticated systems. This paper will take a look at one effort to be interoperable with the new ground and airborne tactical radio, the Single Channel Ground and Airborne Radio System (SINCGARS).

BACKGROUND

It has long been recognized that effective command and control communications on the modern battlefield can provide a significant and decisive advantage.[1] Conversely, if you don't have effective command and control communications (C^3) it can, and probably will be a significant disadvantage. Examples of how ineffective C^3 have worked to our disadvantage have been repeated throughout our combat history.

HISTORY

During the Korean Conflict, close air support (CAS), normally a force multiplier, attacked our own forces, mainly due to inadequate or nonexistent ground to air communications. Naval gunfire support (NGFS) also inadvertently fired on friendly locations due to communications problems during this same conflict. Thirty three years later we still had the same problems. After the Grenada invasion communications problems were highly publicized. The Army forces could not talk to the Navy or Marines on the tactical radio net. During a CAS mission, a Navy A-7 aircraft called in by the Marine Air and Naval Gunfire Liaison Company (ANGLICO), fired on an enemy antiaircraft position that had been abandoned two days prior. One of the U.S. Army forces headquarters had been relocated on the other side of the hill the gun was on. The result was that several Army personnel were wounded, again mainly due to command, control and communications problems.[2]

ELECTRONIC WARFARE

Even with good tactical communications, other problems may be encountered. During the Arab-Israeli War in 1973 the Israelis received artillery fire on their locations within minutes after communicating with their tactical fixed frequency radios. They had been located by direction finding and triangulation techniques and were hindered by and even denied the use of radio communications.[3]

The enemy will also try to deny the use of tactical communications through the use of radio frequency (rf) jammers

tuned to your frequency.

This paper will try to evaluate one solution to these problems of interoperability, direction finding, and jamming. The solution is the SINCGARS radio, a joint Army, Navy, Marine Corps, and Air Force radio system. This evaluation will concentrate on certain operational capabilities and joint interoperability of the system.

SYSTEM DESCRIPTION

Today the VHF-FM (very high frequency-frequency modulation) combat net radio is the primary means of communications for the command and control of all U.S. ground and allied forces. The current family of radios, the AN/PRC-77, AN/VRC-12, and AN/ARC-114 are susceptible to the electronic warfare (EW) techniques. They are designed primarily for voice operation, using 50 kilohertz (kHz) bandwidth channel operation. It can operate on frequencies from 30-76 MHz on 920 separate voice channels.[4]

SINCGARS is scheduled to replace the current family of tactical VHF-FM radios listed above. The primary advantage of SINCGARS over the current radio is that it can operate in a frequency hopping mode which provides a degree of electronic counter-countermeasure (ECCM) (anti-jam) protection. It can also operate in the single channel mode and is interoperable with the current VHF-FM radios in either the clear or secure mode using a KY-57 VINSON communications security (COMSEC) device.[5]

SINCGARS operates over an extended frequency band, from 30-

88 MHz and uses 25 kHz channel spacing in the single channel mode. This provides up to 2320 separate voice channels, an increase of approximately 2 1/2 times over it's predecessor.[6]

In the frequency hopping mode, SINCGARS automatically changes frequency in a pseudorandom manner over the entire 30-88 MHz band, using from 1 to 2320 hopping channels as specified in the Communication-Electronics Operation Instructions (CEOI). Receivers are synchronized with the transmitter through the use of common variables, which are critical to SINCGARS communications. The variables are computer generated by the Battlefield Electronic CEOI System or BECS. The National Security Agency (NSA) and the Army are presently jointly developing this system which will be discussed later.[7]

The ECCM module, as part of the receiver-transmitter (RT), provides the necessary control functions to enable the SINCGARS RT to "randomly" change frequencies. In order to operate in the frequency hopping mode four variables are required. These variables are:

TRANSMISSION SECURITY KEY (TRANSEC) - Controls the transmission security process, or, frequency hopping sequence.

TIME OF DAY (TOD) - Wrist watch accuracy (+/- 4 seconds) time entered into the radio to provide a hopping time reference, or, when to start hopping.

HOPSET - Identifies the frequencies available to hop on and

includes the net identification number or NET ID, which tells SINCGARS where to start hopping.

LOCKOUTS - A frequency, a group of frequencies, or groups of frequencies whose use is either temporarily or permanently restricted for a given area, but only if required.[8] These will then be deleted from the HOPSET, described above.

While in the frequency hopping mode, SINCGARS retains interoperability with single channel U.S. or NATO FM radios through the use of a CUE channel. The single channel radio can alert the SINCGARS radio in the hopping mode by tuning to the CUE frequency and keying the microphone. SINCGARS monitors the CUE channel at all times and notifies the operator when a CUE signal is received. The operator then shifts to the single channel mode and communicates with the caller on the CUE or six other preset single channel frequencies. It therefore complies with NATO standardization agreements (STANAG) 4202, 4204, and 4292.[9] (see Appendix 1 for further information on these standards). A frequency offset of +/- 5 or +/- 10 kHz is available in the single channel mode to help reduce the effects of jamming.

Other additional features include:

- Whisper function which allows the operator to transmit effectively while whispering, as in the case of clandestine operations.

- Digital data transmission capability at rates of 600 bits per second (bps), 1.2 kbps, 2.4 kbps, 4.8 kbps, and 16 kbps.

- Electronic Remote Fill (ERF) in which you can electronically obtain the variables required to implement a new CEOI.

- Built in Test (BIT) will assist the operator or maintainer to discover or isolate a fault in the system.[10]

Lessons learned from the VINSON COMSEC equipment have shown that the inability to communicate is often traced to either the external connections to the VINSON unit, or an incorrect crypto setup.

The first problem was most prevalent in the manpack and vehicular dismountable radios, as their connections were moved more often and the radios were usually exposed. Their connections were therefore more susceptible to the elements and corrosion, causing continuity problems with the VINSON COMSEC unit, which in turn caused communications problems. To solve this problem the SINCGARS Program Manager (PM) was directed to integrate the COMSEC device into the SINCGARS ground radio.[11] The results of this is the Integrated COMSEC unit which is now called the ICOM version of SINCGARS. The ICOM SINCGARS Initial Test and Evaluation will not commence until October, 1989, after 16,000 NON-ICOM radios have been built and fielded.[12]

The second problem of units using incorrect crypto should be solved for the Army. The BECS will include the COMSEC information as part of their output variables. The other Services may still have a problem however, as they are developing different systems similar to the Army BECS.[13]

The RT-1439/VRC is the basic building block for all NON-ICOM SINCGARS configurations. The RT-1523/U is the basic RT

designation for this ICOM unit. It has the same basic characteristics as the NON-ICOM radio except it is slightly bigger and heavier. It is however, lighter and slightly smaller than the combined weight and size of the radio if the VINSON unit is included.[14] Examples of the relative face plate size and layout differences are shown in figure 1 below.

The different configurations and the basic characteristics of the SINCGARS RT as listed in the Test and Evaluation Master Plan (TEMP) can be found in Appendix 1.

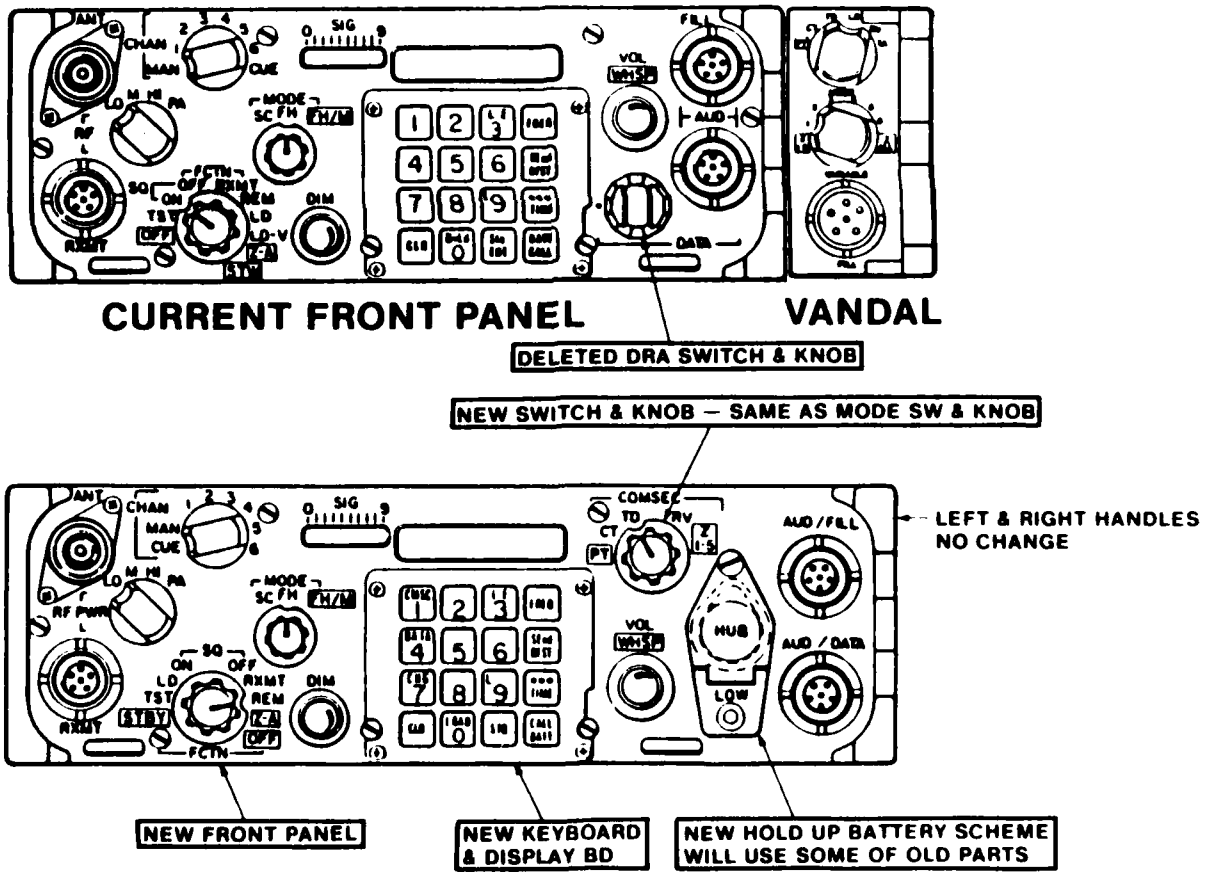

FIGURE 1

ENDNOTES

1. ITT Aerospace/Optical Division. SINCGARS System Document, A Description of the Ground Radio Subsystems. 10 January 1986. p. 1-1.

2. Brigadier General Stephen Silvasy Jr., Operation Urgent Fury. 1 December 1987. Cited with special permission of BG Silvasy.

3. Interview with Yishay Dotan, COL, Israeli Army. International Fellow U.S. Army War College, Carlisle, Pa., 18 September 1987.

4. HQ U.S. Army Communications Electronics Command (CECOM), Single Channel Ground & Airborne Radio System (SINCGARS) Test and Evaluation Master Plan (TEMP), p. 1. (Hereafter referred to as "SINCGARS TEMP").

5. Ibid., pp. 1-2.

6. Ibid., pp. 1-5.

7. Ibid., p. 11.

8. Ibid., pp. 9-10.

9. Ibid., pp. 1-6.

10. "Why We Need SINCGARS," The Voice of SINCGARS, December 1987, p. 2.

11. "How Will SINCGARS Be Secured," The Voice of SINCGARS, April 1985, p. 4.

12. Interview with Angel . Colon, CPT, SINCGARS Program Office, Ft. Monmouth N.J., 15 January 1988.

13. Interview with Thomas Weiner, GM-14, Naval Air Development Center, Communications and Navigation Department, Warminster Pa., 22 December 1987.

14. SINCGARS TEMP, p. 43.

CHAPTER II

OPERATIONAL TESTING

One of the main focuses of this paper is to evaluate SINCGARS in an operational or EW environment. The Test and Evaluation Master Plan (TEMP) specifies: "SINCGARS will be tested as a series of tactical radio nets.....against threat Electronic Support Measures (ESM's) identified in the threat support package in an operational environment;" and, "that SINCGARS be less susceptible than the AN/VRC-12 series radios to: network identification, direction finding; and development of the electronic order of battle."[1]

TEST CONDUCT

The tests conducted to date have included typical combat radio nets used by battalion and brigade levels. The radios were setup and operated in the field by typical soldiers. Nets were of various sizes and were established to assess the following: operator interactions; operating ranges on different frequency bands; antenna types; secure and non-secure modes of operation; and electromagnetic compatibility/vulnerability.[2]

The follow-on operational test and evaluation (FOT&E) for ground SINCGARS units will be conducted from March to May 1988. The tests will be a series of mechanized infantry battalion command field exercises using 100 production SINCGARS, in both vehicular and manpack configurations in a typical operational

deployment. One 96 hour and one 72 hour test are to be conducted. All radios will be in the secure, frequency hopping mode.[3]

The SINCGARS integrated schedule chart is shown in Appendix 2. It contains all test schedules for each portion of the SINCGARS and major associated hardware through 1991.

SINCGARS KOREA FIELDING

One hundred twenty SINCGARS radio systems have been fielded (December, 1987) to the demilitarized zone (DMZ) in Korea to solve a critical mission requirement for VHF-FM communications. The radios fielded will be permanently retained in the DMZ. In addition to fulfilling the mission requirement, early fielding will provide feedback to the SINCGARS program concerning additional doctrinal areas that need to be documented. It will also provide additional field data on the radios performance.[4]

TEST RESULTS

Although the specific results are beyond the scope of this paper, the test data indicates that the system has satisfactorily completed the above criteria. The author is therefore satisfied that the SINCGARS system will meet the capabilities required in an operational environment and will not cover these aspects further.

ENDNOTES

1. HQ U.S. Army Communications Electronics Command (CECOM), Single Channel Ground & Airborne Radio System (SINCGARS) Test and Evaluation Master Plan (TEMP), pp. 33-34 (hereafter referred to as "SINCGARS TEMP").

2. Ibid., pp. 38-39.

3. Ibid., pp. 39-40.

4. "SINCGARS Fielded in Korea," The Voice of SINCGARS, December 1987, p. 1.

CHAPTER III

INTEROPERABILITY

BACKGROUND

The initial SINCGARS development plan was the Army would do the development exclusively, including an airborne version. The services would then buy under the Army contract for their needs and requirements. The Marines and Army ground forces would use identical hardware. The Navy would use the vehicular long range radio for shipboard use.[1] For Naval (including Marine) and Air Force aircraft the plan was to use the airborne version or the ARC-201. This is the radio that the Army would use in it's helicopters and other designated aircraft.[2]

AIRBORNE VERSION

Both the Navy and Air Force decided however, that since the ARC-201 would only replace the VHF-FM portion of their radios, they would incorporate the SINCGARS features into their new developmental or existing radios, the ARC-182 for the Navy, and the ARC-186 (now the ARC-205) for the Air Force.[3] This would not only cut down on the number of radios supported by their respective supply systems, but also eliminate the space, weight, power and cooling requirements of the additional radio, which are already critically constrained in today's fighter and attack

aircraft. If room was available, or the aircraft had two radios, the redundancy of the radios over their entire design would be a good idea. The operating characteristics of each radio is shown below in table 1.[4]

SERVICE	RADIO	FREQ.	BAND	USE	FREQ HOP
ARMY	ARC-201	30-88 MHz	VHF-FM	AIR-GND	YES
AIR FORCE	ARC-205	30-88 MHz	VHF-FM	AIR-GND	YES
		108-157 MHz	VHF-AM	AIRWAYS	YES
NAVY	ARC-182	30-88 MHz	VHF-FM	AIR-GND	YES
		108-174 MHz	VHF-AM	AIRWAYS	NO
		" - " "	VHF-FM	MARITIME	NO
		" - " "	VHF-AM	SONOBUOY	NO
		225-400 "	UHF	MIL ABN	NO

TABLE 1

Incorporating this concept turned out to be a very difficult task. The frequency hopping algorithm was not covered by the original Army contract with ITT. This problem essentially widened the gap on fielding Navy and Air Force aircraft with SINCGARS capability. In modification 3, December 1983, to the Army's contract with ITT, it was agreed that ITT would work with anyone the Army designated in order to ensure interoperability. However, ITT would charge for this additional work.[5]

To avoid further delays in development, the Air Force eventually bought (for $75,000) the frequency hopping algorithm data from ITT in the fourth quarter, 1985. They did this through Cincinnati Electronics (CE), their prime contractor for the ARC-205. The algorithm was shared with the Joint Tactical Command, Control, and Communications Agency (JTC^{3}A), whose mission is to insure interoperability between the services. They in turn

issued the SINCGARS waveform specification as JTC[3]A Standard 9001 in mid-1986.[6] In November, 1986, the Army's Theater Tactical Command and Control panel noted errors in this documents draft. While the errors have now been corrected (November, 1987), the document is not in MILSTANDARD format, but rather in "tutorial language" or "this is the way ITT did it."[7] While the Navy and Air Force are implementing the algorithm in their own fashion, they are concerned over what they perceive as changes well into the development cycle.[8] Initial indications, however, are that both versions can "talk" to the Army ground NON-ICOM radio in the non-secure frequency hopping mode. No tests have been conducted to date outside of the laboratory environment concerning interoperability between services.[9] Therefore, questions of interoperability concerning both the secure mode and the ICOM version radio remain open.

The next test, an operational one at Fort Sill, is scheduled from late March to May, 1988. Although the Army ground NON-ICOM radio initially had reliability problems, they have now been solved. They are now receiving production radios which will undergo Follow-on Test and Evaluation (FOT&E) during this test period. The Army airborne radio, the ARC-201, concurrently will undergo First Article Test (FAT). While both the Navy and Air Force have been invited, only the Air Force has indicated that they will attend and participate.[10] The Air Force subsequently said they will attend, but will not have any hardware ready at this time.[11]

SHIPBOARD VERSION

As stated earlier the Navy shipboard system was to be the vehicular long range radio, the VRC-90. The Navy anticipated that it would just need to add some peripherals to make the system work. Upon further investigation however, because it was discovered what they would have to interface with onboard Navy ships, the Naval Sea Systems Command (NAVSEA) found it would have to virtually rebuild the present system that the VRC-46 now uses. They would have to build or buy the following: a new frequency hopping filter; a new power supply; new multi-couplers for multiple VHF-FM installations; a new antenna system; and a new interface box for the ships audio system.[12]

Because of this, the Navy opted to build its own version of SINCGARS for shipboard use. NAVSEA put out a Request for Proposal to meet the performance specification of the ITT SINCGARS for the whole Navy system. Presently there are six contractors bidding for this contract, including ITT. A fixed price contract award is expected in FY-90. A minimum of two years is expected for development and another two years for system testing and Operational Evaluation (OPEVAL). The Initial Operational Capability (IOC) is now expected in FY-94.[13]

The Marine Corps is scheduled to have SINCGARS capability in FY-92.[14] This has a negative impact on the Amphibious portion of the Navy and its ability to communicate effectively with the Marines.

TECHNICAL INTEROPERABILITY INITIATIVES

To ensure technical interoperability with the Navy and Air Force Full Scale Engineering Developments (FSED), several initiatives have been undertaken. They are as follows:

a. Adherence to JTC^{3}A Standard 9001

b. Loaning of currently existing SINCGARS hardware and materiel specifications to the USAF and USN for their use in FSED programs.

c. The provision for ITT engineering support to the USAF and the USN.

d. Conduct by the USAF and the USN of technical Development Testing (DT).

e. Development of a MIL-STD-188 series standard for VHF-FM systems.[15]

BATTLEFIELD ELECTRONIC CEOI SYSTEM (BECS)

Frequency management has been a problem since radios came into vogue. From the earliest days of amateur radio, it became apparent that bands of frequencies had to be allocated to prevent interference and overloading of one band or another. Agencies now exist worldwide to control the radioways. Even the Military is controlled by frequency use, power limitations, and type of emission.

With the advent of SINCGARS, frequency management problems have intensified greatly due to its frequency hopping capability.[16] The need for a more automated system to specify the control variable of the SINCGARS became apparent, and the Battlefield Electronics CEOI System (BECS) was conceived.[17]

System Description

The BECS is composed of the Basic Generating Unit (BGU), which will generate and distribute SINCGARS variables, and an Electronic Notebook (EN), which will only distribute the variables. It is a Non-Developmental Item (NDI) procurement. The BGU is composed of a Desk Top Computer (DTC) (presently a Hewlitt-Packard-111), HP disk drive, printer, interface device, and peripherals. The EN will be a small hand-held computer, whose size is not to exceed the breast pocket of the Battle Dress Uniform (BDU) and will weigh no more than one pound.[18]

The system will be capable of generating, displaying, printing, and storing CEOI information, including net descriptions, callsigns, all four bands of frequencies (HF, VHF-FM, VHF-AM, AND UHF), and all SINCGARS operating variables. It will be able to transfer SINCGARS load variables to the EN or receive variables from the EN. The variables will also be transferable between EN and EN.[19]

BECS DEVELOPMENT

The BECS is being designed primarily to support Army needs. As such, it does not presently fulfill all Navy, Marine Corps, or Air Force needs. The Marine Corps wants to use a version of BECS running on Zenith Z150's or Z248's. The Air Force wants to extend the frequency hopping portion of the CEOI to 157 MHz. The Air Force system is called the Key Distribution Management System

(KDMS). The Navy has not yet decided how it intends to implement this. NSA will not change the software, which leaves it up to the Services to do.[20] A need exists, however, to develop a joint version of the BECS software that is transportable to other DTC's that the other services are presently using as a standard, or others that will be used due to new technological advances. It also must meet the other Services' needs.

JOINT AGENCY RESPONSIBILITIES

The TEMP lists the joint Agency's organizational responsibilities as:

> "The JTC^{3}A will assist in developing, testing, and maintaining all developmental interface design standards to be used by C^2 elements. Plan,conduct, and evaluate compatibility and interoperability testing of service/agency C^2 systems, and provide recommendations to the JCS for certification of systems for combined operations. JTC^{3}A will be responsible for developing and maintaining the SINCGARS waveform specification, JTC^{3}A 9001. They will also ensure that Joint Service interoperability testing is conducted and approve all Joint aspects of test plans."

From this we might interpret that the Agency has the authority to ensure interoperability, but only if the service components provide it with requisite data, and then it is only advisory in nature. In response to a General accounting Office (GAO) report, "INTEROPERABILITY: DoD's Efforts to Achieve Interoperability among C3 Systems," dated April 27, 1987, the Assistant Secretary of Defense for Command, Control, Communications and Intelligence noted:

"FINDING J: Agency Authority. The GAO reported that the Agency role in assuring interoperability is primarily an advisory one. According to the GAO, if the Director is unable to resolve interoperability problems in conjunction with the Services or Unified Commands, he reports the problem to the JCS and/or the OSD, which retain the authority to disapprove Service programs. The GAO concluded that the Agency should help to alleviate some interoperability problems in the short term and raise the awareness of DoD components on the importance of considering interoperability in their C^3 decisions."

DoD concurred, but noted that only the Secretary of Defense has the authority to disapprove a program, not the JCS.[20]

ENDNOTES

1. Interview with Howard Benson, Space and Naval Warfare Systems Command, Advanced Concepts Division, SINCGARS Shipboard Program Manager, Washington, 17 March 1988.

2. Interview with Thomas Weiner, Naval Air Development Center, Communications and Navigation Department, Warminster, Pa., 22 December 1987.

3. Ibid.

4. Ibid.

5. Telephone interview with Niel Hansen, Air Force Systems Command, Electronics Systems Division, TVCS, 16 March 1988.

6. Ibid.

7. Interview with Angel Colon, CPT, SINCGARS Program Office, Ft. Monmouth N.J., 15 January 1988.

8. Weiner, 22 December 1988.

9. Colon, 15 January 1988.

10. SINCGARS TEMP, p. b.1.

11. Hansen, 16 March 1988.

12. Benson, 17 March 1988.

13. Ibid.

14. Interview with Rodney Wijas, MAJ, USMC, SINCGARS Program Office, USMC liaison Officer, Ft. Monmouth, N.J., 15 January 1988.

15. Colon, 15 January 1988.

16. Ibid.

17. Ibid.

18. HQ U.S. Army Communications Electronics Command (CECOM), Battlefield Electronic CEOI System (BECS) Test and Evaluation Master Plan (TEMP), Annex E to SINCGARS TEMP, 5 MAY 1987, pp. 1-4.

19. Ibid.

20. Weiner, 22 December 1987

21. Thomas P. Quinn, Acting Assistant Secretary of Defense for Command, Control, Communications and Intelligence, letter to the General Accounting Office concerning the DoD response to the GAO Final Report "INTEROPERABILITY: DoD's Efforts to Achieve Interoperability among C3 Systems," 28 September 1987, p. 11.

CHAPTER IV

CONCLUSIONS

It is quite evident that Joint communications interoperability is not only desired by the Services, but required in order to fight effectively and win. There appears to be an inertia of Service parochialism that is impeding the required interoperability. From my own general knowledge the problem is not at the lower levels, where the men in the field have to make it work. Nor is the problem at the senior levels, since all top-level plans require components to participate jointly in almost any conflict. That leaves the middle levels of component management, and, even here it's not necessarily their fault.

In the Defense Reorganization Act of 1986, the Services,in the Acquisition arena, were restructured only at the top. In the area of interoperability they did not put "teeth" in the JTC^3A. There is presently no Joint Operational Requirement for SINCGARS, and no Joint Program Manager. So the Services put precedence on things that they want, which is only natural in this era of dwindling budgets. This leads, however, to the problems and delays that are shown in this paper. Although technical interoperability problems will be solved, delays in IOC of a system, in essence, reduces or eliminates interoperability until systems are fielded to the majority of players.

An example is the Marine Corps which will have the SINCGARS radio in 1992. The ships that they will be operating from,

however, will retain the VRC-46 until 1994. Although they will be able to communicate in the fixed frequency single-channel mode, their communications will be susceptible to the EW threat that SINCGARS was designed to combat. Once the Marines are ashore and elect to use the full capabilities of the radio, the ship will not be able to monitor the shore communications. Being able to follow the action real time, in order to provide emergency reinforcement or resupply, is an asset that will be lost. They will have to rely on separate message situation reports, which often do not paint the entire picture. It also increases the communications load and still subjects these communications to jamming and direction finding.

Certainly there will always be delays and slips in developmental items with sophisticated systems such as SINCGARS. However, we must and can do better.

CHAPTER V

RECOMMENDATIONS

In order to solve the problems of the sort described in this paper, several recommendations need to be addressed.

The first is that a Joint Required Operational Capability (JROC) be written so all Service components have direction for the program in addition to obtaining requisite funding.

The second is that the JTC^{3}A have a role that is not just advisory in nature, but that it must ensure interoperability. The JROC would be their "hammer".

Third, a lead service and Joint Program Manager should be appointed to coordinate all the Services efforts. He would have a joint development and test schedule that would require Services to: 1) ensure they have the requisite data for their developmental items; 2) require them to actively participate in Joint tests, and not just invite them as is presently done; 3) require that all Services have the system fielded at relatively the same time.

While the three recommendations listed above are not the only ones that could be made, they are the most important ones. They are the ones that could make a major difference in how we procure equipment, it's cost and developmental time. Although it would take a little longer in the initial stages, I believe both time and money would be saved over the development cycle.

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SINCGARS CONFIGURATIONS

SINCGARS GROUND

NOMENCLATURE	FUNCTION/NSN/LIN	COMPONENTS RT-1439	AM-7239	AS-3684	CY-8346	AM-7238	REPLACES
AN/PRC-119	Manpack*	1			1		AN/PRC-25, AN/PRC-77
AN/VRC-87	Vehicular Short Range	1	1	1			AN/VRC-53, AN/VRC-64
AN/VRC-88	Vehicular Short Range/Dismountable*	1	1	1	1		AN/GRC-125, AN/GRC-160
AN/VRC-89	Vehicular Long Range/Vehicular Short Range	2	1	2		1	AN/VRC-12, AN/VRC-47
AN/VRC-90	Vehicular Long Range	1	1	1		1	AN/VRC-43, AN/VRC-46
AN/VRC-91	Vehicular Long Range/Vehicular Short Range/Dismountable*	2	1	2	1	1	AN/VRC-46 + AN/GRC-160
AN/VRC-92	Dual Vehicular Long Range	2	1	2		2	AN/VRC-45, AN/VRC-49

*Also issued an AS-3683

BASIC/ANCILLARY ITEMS

Receiver/Transmitter	RT-1439/VRC	Antenna, Manpack	AS-3683
IVRCU	C-11291/VRC	Antenna, Vehicular	AS-3684
ECCM Fill Device	MX-10579	Adapter, Vehicular	AM-7239
Adapter Cable (ECCM Fill)		Mounting Base	MT-6352
Control, Securable Remote*	C-11561/U	Mounting Base, Power Amplifier* (AN/VRC-92 only)	MT-6353
Power Amplifier	AM-7238	Loudspeaker*	LS-671
Battery Case	CY-8346	VINSON Mount*	MT-6429

*Development Items

TABLE A1-1

SINCGARS CONFIGURATIONS (Continued)

SINCGARS AIRBORNE*

NOMENCLATURE (RESERVATION)	CONFIGURATION	ASSOCIATED ITEMS RTs	CONTROL HEAD	MOUNTS/ADPTR TRAYS	REPLACES
(RT-1476/ARC-201(V))	Panel Mounted Radio	1			AN/ARC-114, AN/ARC-186 (FM only)
(RT-1477/ARC-201(V))	Remote Mounted Radio W/ dedicated Control Head	1	1	1	AN/ARC-54, AN/ARC-131 AN/ARC-186 (FM only)
(RT-1478/ARC-201(V))	Remote Mounted MIL-STD 1553B Compatible	1		1	AN/ARC-186 (FM only)

BASIC/ASSOCIATED ITEMS

Airborne SINCGARS Radio	Radio Set AN/ARC-201(V)
Control Radio Set	C-11466/ARC-201(V)
AN/ARC-131 Mounting Adapter (Mounting Base Adapter Tray)	MT-6373/ARC-201(V)
Base, Hard Mount	MT-6374/ARC-201(V)
Airborne Data Rate Adapter	CV-3885/ARC-201(V)

*Nomenclature Reservations as of 29 Mar 1984

TABLE A1-1

BASIC CHARACTERISTICS OF SINCGARS RT

	Plain (RT-1439)	ICOM (RT-1523/U)
Dimensions		
Height	3.3 inches	3.34 inches
Width	9.3 inches	10.68 inches
Length	9.7 inches	9.94 inches
Weight		
RT	12.9 lbs	13.87 lbs.
Battery	(BA-5513/U) 2.1 lbs	(BA 5590/U) 2.25 lbs.
Frequency Range		30.000 to 87.975 MHz in 25 kHz intervals.
Number of possible operating frequencies		2320
Timing accuracy		± 5 ppm
Frequency offset ability		± 5 kHz and ± 10 kHz (single channel only)
Tuning facility		Electronic; manual tuning by keyboard; 6 presets (each for single channel and FH)
Type of modulation		Frequency modulation
Operating voltage		12.5 V dc nominal 24 V dc nominal (vehicular installations)
Operating temperature range (ambient)		-60° F to +125° F (-51°C to +52°C)
Built-In-Test (BIT) capability		BIT checks for the presence of ECCM Module and Data Rate Adapter (DRA) and the operational status of the ECCM module, DRA and the balance of the RT modules.
Audio response capability		300 to 3000 Hz
Audio/digital data input and output facilities		Two 6-pin front panel connectors for handset or for connection to vehicular mounting adapter.

RF power output	Power	Range*
Low (LO)	500 microwatts	300 meters
Medium (M)	160 milliwatts	4 km
High (HI)	4 Watts	8 km
Power Amp (PA) (Power amplifier external to RT)	50 Watts	35 km

* Effective Range varies with terrain, line of sight conditions and other propagation conditions

TABLE A1-2

BASIC CHARACTERISTICS OF SINCGARS RT
(Continued)

Power drain (nominal) during transmit	1A for LO and M power output 2A for HI power output 7A for PA power output
Transmitted carrier deviation (voice)	Input voltage of 1.4 mV to 140 mV at the handset audio input terminals in the frequency range of 300 to 3000 Hz will deviate the transmitted carrier ± 6.5 kHz
Audio input impedance (microphone)	150 ohms (H-250 compatible)
Audio input level (minimum)	1.4 mV normal; 0.4mV whisper
Squelch trigger ability (transmit)	Squelch tone signal is 150 Hz. (single channel plain text, with 3Khz deviation, ± 500 Hz)
Receiver RF signal sensitivity	0.35 microvolts minimum
IF Signal/Noise Requirements	SC Analog - 4db nominal for 10dB SINAD. SC Digital - 3.8 dB nominal for 10^{-1} BER. FH - 4.6 dB nominal for 10^{-1} BER
STANAG compliant	STANAG 4202: Transmission Envelope Characteristics for high reliability data processing equipment over a single channel radio links. STANAG 4204: Technical Standards for single channel VHF radio equipment. STANAG 4292: Standards to achieve communication between tactical combat net radio equipment designed to STANAG 4204 and FH radios operating in the same (30-88 MHz) band.

TABLE A1-2

SINCGARS
INTEGRATED SCHEDULE CHART

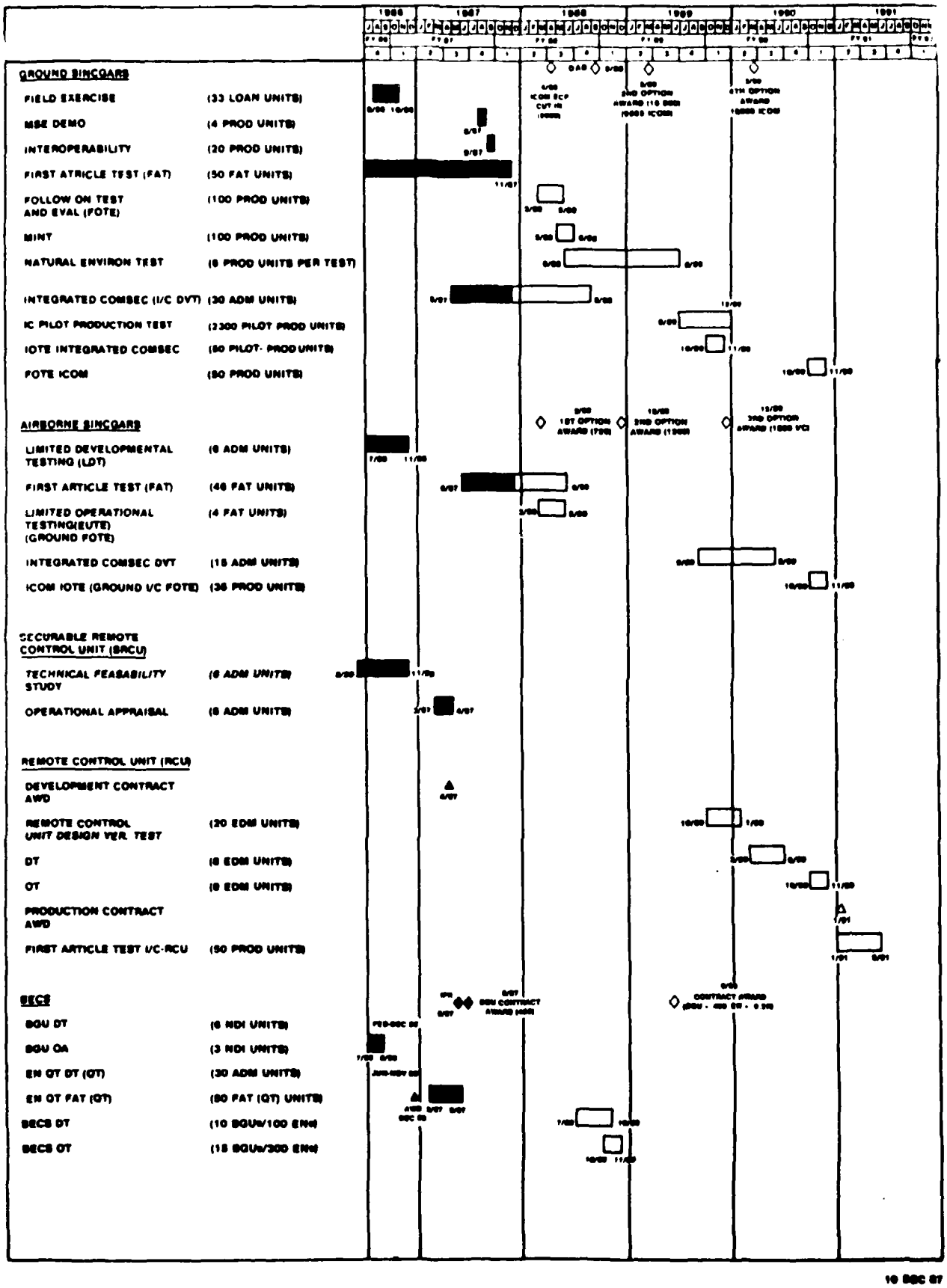

FIGURE A2-1

END

DATE

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8-88

DTIC